

REMARKS

The above amendments to the above-captioned application along with the following remarks are being submitted as a full and complete response to the Final Office Action dated July 27, 2005 (U.S. Patent Office Paper No. 07122005). In view of the above amendments and the following remarks, the Examiner is respectfully requested to give due reconsideration to this application, to indicate the allowability of the claims, and to pass this case to issue.

With the response filed on April 26, 2005, Figures 23 and 25 were amended as outlined in the Letter to the Office Draftsperson, and as shown in the accompanying revised sheets of drawings for Figures 23 and 25, also filed on April 26, 2005. Acknowledgment of entry of the amendments to the Drawings is respectfully requested.

It is respectfully noted that the previous Office Action states that dependent Claims 5, 7 and 8 were objected to as being dependent upon a rejected base claim (U.S. Patent Office Paper No. 02102005, page 2). However, in the Final Office Action, it is also respectfully noted that while Claims 5, 7 and 8 are now indicated as being rejected (Final Office Action, page 1), the rejections set forth in the Final Office Action do not specifically address the rejection of these Claims 5, 7 and 8. Therefore, it is respectfully requested that a new Office Action, with a restarted period for response, be issued to specifically address Claims 5, 7 and 8.

Status of the Claims

As outlined above, Claims 1 through 11 are presently pending in this application. Claims 1, 2, 4, 6 and 8 are being amended to correct formal errors and to more particularly point out and distinctly claim the subject invention. Entry of the amendments to Claims 1, 2, 4, 6 and 8 is respectfully requested.

Prior Art Rejections

Claims 1, 2, 4 and 6 were rejected under 35 U.S.C. §103(a) over the admitted prior art, hereinafter referred to as the Admission, in view of U.S. Patent No. 6,804,245 to Mitchem et al., hereinafter referred to as the Mitchem '245 patent. This rejection is respectfully traversed.

Claim 3 was rejected under 35 U.S.C. §103(a) over the Admission in view of the Mitchem '245 patent, and further in view of U.S. Patent No. 6,374,336 to Peters et al.,

hereinafter referred to as the Peters '336 Patent. This rejection is respectfully traversed.

Claims 9 through 11 were rejected under 35 U.S.C. §103(a) over the Admission in view of the Mitchem '245 patent, and further in view of U.S. Patent No. 5,680,539 to Jones, hereinafter referred to as the Jones '539 patent. This rejection is respectfully traversed.

The above rejections under 35 U.S.C. §103(a) of Claims 1 through 4, 6 and 9 through 11 will be considered collectively.

It is respectfully submitted that the Admission, in combination with the Mitchem '245 patent, the Peters '336 patent, and the Jones '539 patent, do not disclose, teach or suggest, among other features:

clustering disk connection means which connects a plurality of disk controllers, and a switch installed in the clustering disk controller and connected to the channel control units and host computer, wherein the switch comprises a data table for holding correspondence information between a destination channel control unit which is an access destination set by the host computer and a channel control unit which actually transfers the access request, as respectively recited in Claim 1;

clustering disk connection means which connects a plurality of disk controllers, and a switch installed in a clustering disk controller and connected to the channel control units and host computer, wherein the switch comprises a data table for holding information on whether or not to transfer data to a different channel control unit from the channel control unit which received the access request from the host computer, as respectively recited in Claim 2;

wherein plural channel control units can be specified as the destination of the access request from the host computer, and the data table stores a probability that an individual channel control unit of the plural channel control units will be selected as a channel controller which actually forwards the access request, as respectively recited in Claim 3;

a service processor (SVP) which manages the information in the clustering disk controller and modifies the data table, as respectively recited in Claim 4;

clustering disk connection means which connects a plurality of disk controllers, and a switch equipped with a data table for transferring an access request from a host computer to the channel control units, and the method

including a step of transferring an access request from the host computer to a predetermined channel control unit based on the data table, as respectively recited in Claim 6;

wherein the SVP looks up load information for the channel control units, and modifies the data table so that an access request from the host computer addressed to a channel control unit under heavy load, is transferred to a channel control unit under low load, as respectively recited in Claim 9;

wherein the SVP looks up fault information for the channel control units, and modifies the data table so that an access request from the computer addressed to a faulty channel control unit, is transferred to a normal channel control unit, as respectively recited in Claim 10; and

wherein the SVP looks up load information for the channel control units, and modifies the data table so that the processing level with respect to the channel control unit under low load is increased, as respectively recited in Claim 11.

The present invention provides a clustering disk controller including clustering disk connection means which connects a plurality of disk controllers, and its load balancing method, whereby a switch holding a table can modify a destination of a request from a host computer, whereby the switch transfers an access request to another channel according to a destination channel status, such as a heavy load or fault, and the channel which received the request processes the request by proxy for load balancing between internal disk controllers, as respectively recited in the methods and apparatus of Claims 1 through 4, 6, and 9 through 11.

Further, such above-described features are not disclosed in the Admission, in combination with the Mitchem '245 patent, the Peters '336 patent, and the Jones '539 patent, in relation to a switch holding a table for modifying a destination of a request from a host computer, whereby the switch transfers an access request to another channel according to a destination channel status, such as a heavy load or fault, and the channel which received the request processes the request by proxy for load balancing between internal disk controllers, as respectively recited in the method and apparatus Claims 1 through 4, 6 and 9 through 11 of the present invention.

Therefore, the above described features of clustering disk controllers and control methods of a disk subsystems, such as respectively recited in Claims 1, 2, 3, 4, 6, 9, 10 and 11, are not obvious in view of the respective combination of the Admission, in view of the

Mitchem '245 patent, the Peters '336 patent, and the Jones '539 patent.

Claims 1, 2, 4 and 6

Also, as to Claims 1, 2, 4 and 6, it is respectfully submitted that, in addition to the foregoing, Claims 1, 2, 4 and 6 are not obvious over the Admission in view of the Mitchem '245 patent.

Claims 1, 2 and 6 include a recitation of a clustering disk connection means. The position of the Examiner that the "connection means which connects said plurality of disk control units" corresponds to the "channel" 2 in Figure 2 of the above identified application (Final Office Action, page 4) is respectfully traversed.

It is respectfully submitted that, in the present invention, the "connection means which connects said plurality of disk control units" refers to the "connecting means among disk controllers" 20 illustrated in Figure 1 of the above identified application, with a disk controller, as respectively recited in amended Claims 1 through 11, corresponding to a disk controller 10 in Figure 1, or in other Figures, of the above identified application.

Therefore, the connecting means 20 illustrated in Figure 1 of the above identified application, as a clustering disk connecting means, enables communication by a channel control unit 11 of one disk controller 10 without going through a channel control unit 11 of another disk controller 10, such as in the case of a heavy load or a fault, for example.

Further it is respectfully submitted that while Figure 3 of the above identified application includes a connecting means 20, Figure 3 does not have a switch and thus does not have a clustering disk connection means as in the present invention.

In this regard, since the SAN switch 39, in Figure 2 of the above identified application, is based on a Fibre Channel (FC), i.e., a general protocol, a channel control unit has to communicate using FC packets, and another channel control unit naturally has to analyze the FC packets. Meanwhile, in the embodiment of the clustering disk controller of the present invention illustrated in Figure 1 of the above identified application, the connection means 20 enables communication by a channel control unit 11 of a disk controller 10 without going through the channel control unit 11 of another disk controller 10, such as in the case of a heavy load or a fault, for example. Also, the clustering disk controller of the present invention is also different from the combination of Fig. 3 of the above identified application and a SAN switch, as regards transferring requests to a channel control unit different from the destination channel control unit.

As to the Mitchem '245 patent, in contrast, the Mitchem '245 patent is directed to a shared route lookup table for a fiber channel switch directed to a route table for ports in a switch 100 (Col. 4, lines 18-26), and is directed to exit port identification (Col. 7, lines 28-46).

Also, in contrast, the switch according to the Mitchem '245 patent does not transfer packets to a port connected to a destination with a different address from that given in the packets. Meanwhile, the switch 30 according to the present invention, such as illustrated in Figure 1 of the above identified application, can transfer packets to a port connected to a channel control unit different from the destination channel control unit given in the packets.

In contrast to the Mitchem '245 patent, the switch of the present invention, such as recited in Claims 1, 2 and 6, allows a data packet addressed to a certain channel control unit to be transferred to a different channel control unit, as, for example, when the certain channel control unit is too busy to process the data and instead the different channel control unit should handle the processing of the data.

Also, as to Claim 2, Col. 7, lines 28-46 in the Mitchem '245 patent description is about a method for searching for an exit port from Destination ID, D_ID, i.e., it is about a method for searching for a port connected to a destination channel control unit. Thus, it is respectfully submitted that, the Mitchem '245 patent does not teach transferring requests to a channel control unit different from the destination channel control unit.

Moreover, as to Claim 4, it is respectfully noted that Fig. 3 of the above identified application does not disclose modification of a data table, in that in Figure 3 of the above identified application does not disclose a distribution table corresponding to a data table.

Furthermore, as to Claim 4, the description at Col. 7, lines 28-46 in the Mitchem '245 patent relates to a searching operation, and not about rewriting steps. It is assumed that the above portion in the Mitchem '245 patent description can be interpreted as including writing data in such a manner that the data can be read according to a relevant algorithm.

Also, it is respectfully noted that the Mitchem '245 Patent does not teach means for obtaining information about the inside of the connection destination, or means for rewriting the central route table from the connection destination.

In contrast, as to Claim 4, in the present invention a service processor (SVP) can manage the information about the inside of the disk controller and can modify the data table. For example, in Figure 11 of the above identified application, the information about the

inside of the disk controller is managed at step 1 and then the data table is modified at step 6 or 10, thereby obtaining the effect of load balancing.

Claim 3

It is respectfully submitted that Claim 3 is not obvious over the Admission in view of the Mitchem '245 patent, and further in view of the Peters '336 Patent.

As to Claim 3, it is respectfully noted that a method of storing probabilities, for example, is shown in 31 of Fig. 4 of the above identified application, and pages 11 through 13 of the above identified application describe an exemplary method of transferring requests on a probabilistic basis using the storing method illustrated in Figure 4 of the above identified application.

Further, in contrast, the Peters '336 patent is directed to a probability distribution for selecting a storage unit for storing a segment and its redundancy information may be uniform over all the storage units (Col. 7, lines 25-30).

In contrast, the Peters '336 patent teaches selecting a storage unit for storing a segment on a probabilistic basis, but not selecting a storage unit for an IO request. In the Peters '336 patent, correlation of storage units selected on a probabilistic basis with segments is recorded in a data structure mapping segments of data to storage units, as shown in Figs. 2A and 2B of the Peters '336 patent, and the destination of an IO request is decided based on the above data structure in a determined manner.

If the switch 30 according to the present invention were applied to the computer network 46 in Figure 1A of the Peters '336 patent, it is respectfully submitted that it is likely inconsistencies would be caused in the storage system. However, in the present invention, the connection means can achieve consistencies in the storage system without putting an unnecessary load to other channel control units.

In other words, in the present invention, since the clustering disk controller having the connection means includes a data table showing the channel control unit for transferring a request on a probabilistic basis, it is possible to perform load balancing between the channel control units, thereby promoting maintenance of error-free operation of the storage system.

Claims 9, 10 and 11

It is respectfully submitted that Claims 9 through 11 are not obvious over the Admission in view of the Mitchem '245 patent, and further in view of the Jones '539 patent.

In contrast, the Jones '539 Patent is directed to a disk array system, whereby the disk array includes a plurality of disk drives, wherein when a new drive is inserted in the disk array, the disk controller performs data reconstruction operations to place data on the new drive. (Col. 10, lines 9-15).

As to Claim 9, in the Jones '539 patent, the execution queue is adjusted between host requests and rebuild requests so as to avoid performance deterioration in one disk array controller, such as¹⁵ apparent from Figs. 4 and 7 in the Jones '539 patent.

Meanwhile, in the present invention, load balancing is performed between the plural channel control units (See Figures 11 and 12, etc. in the above identified application). Thus, it is respectfully submitted that even by combining the Mitchem '245 patent with the Jones '539 patent, it is not likely to reach load balancing by changing a transfer destination, and so it is not also not likely to obtain the effect of balancing the load in the channel control units, as in the present invention, such as in the disk subsystem control method recited in Claim 9.

Claim 10

As to Claim 10, it is respectfully noted that the Final Office Action states that "Neither the admission nor the Jones '539 patent discloses the SVP looks up load information. . .". (Final Office Action, page 10) However, it is respectfully noted that in Claim 10 it is recited that "the SVP looks up fault information".

As to Claim 10, in contrast, it is respectfully submitted that, in the Mitchem '245 patent, although the port status can be known, the fault status of the connection destination channel control unit apparently can not be known.

Claim 11

As to Claim 11, the Final Office Action states that the Mitchem '245 patent "teaches blocking traffic from certain ports. . .". (Final Office Action, page 10) However, it is respectfully submitted that "blocking traffic", i.e., zoning, is normally set by an administrator, i.e., and it is a static setting. Thus, it is respectfully submitted that such static zoning typically can not be readily used for dynamic load balancing, as in the present invention.

However, even assuming such static zoning could be used, it is respectfully submitted that the Mitchem '245 patent does not disclose means for obtaining information about whether the load status of each channel control unit is high or low. Further, while

measuring the traffic load may be possible using other switches, the load inside the storage units likely can not be known.

Furthermore, it is respectfully submitted that the Mitchem '245 patent does not teach issuing a command to increase the processing amount of the channel control unit itself, such as shown, for example, in step 4 in Figure 21, step 5 in Figure 19, and in step 6 in Figure 23 of the above identified application.

Thus, the Mitchem '245 patent does not disclose a SVP that looks up load information for the channel control units, and modifies a data table so that the processing level with respect to the channel control unit under low load is increased, as respectively recited in Claim 11.

In view of the foregoing, it is respectfully submitted that Claims 1 through 4, 6, and 9 through 11 are not obvious over the Admission, in view of the Mitchem '245 patent, the Peters '336 patent, and the Jones '539 patent, as these references are respectively applied in the forgoing rejections.

Withdrawal of the rejections of Claims 1 through 4, 6 and 9 through 11 under 35 U.S.C. §103(a) is respectfully requested.

Reconsideration and allowance of Claims 1 through 11 are respectfully requested.

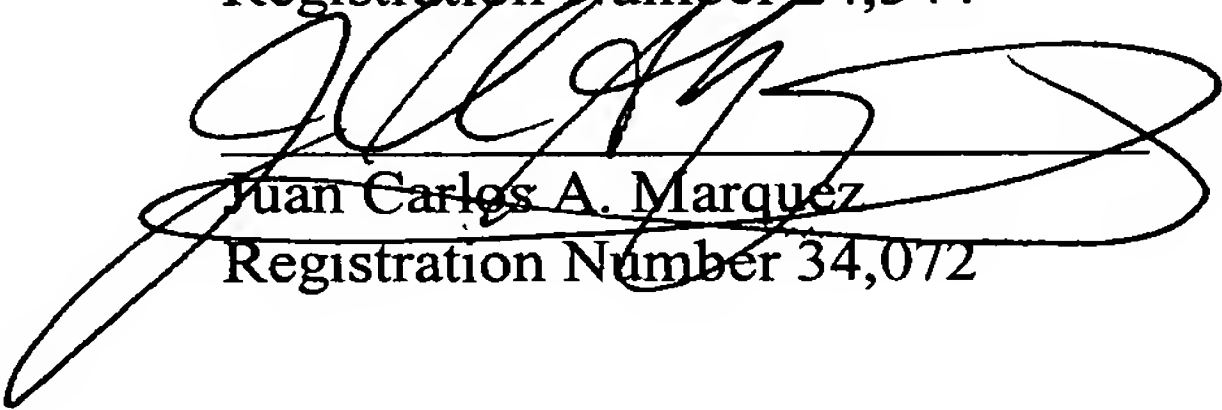
Conclusion

In view of all the above, Applicants respectfully submit that certain clear and distinct differences as discussed exist between the present invention as now claimed and the prior art references upon which the rejections in the Office Action rely. These differences are more than sufficient that the present invention as now claimed would not have been anticipated nor rendered obvious given the prior art. Rather, the present invention as a whole is distinguishable, and thereby allowable over the prior art.

Favorable reconsideration of this application as amended is respectfully solicited. Should there be any outstanding issues requiring discussion that would further the prosecution and allowance of the above-captioned application, the Examiner is invited to contact the Applicants' undersigned representative at the address and telephone number indicated below.

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